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Deep Learning Approach for Pole like Road object Detection Using LiDAR–Orthophoto Fusion

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***Abstract*-** With the growth of computer vision, digital image processing is necessary to provide a clear image to the user. In existing research detection of pole side objects with the help of an LiDar which only detect the object but not with clear transparency in proposed research we are try to give the clear vision of the pole side object with the help of fusion of LiDar and orthophoto and also improve the accuracy of an image.

***Keywords*:** Digital image processing, image recognition, SVM, Accuracy, image enhancement, Machine learning, Histogram

I. INTRODUCTION

Pole-like objects such as traffic signs, lampposts and tree trunks are an important part of road environments. For detection of these objects in road environment, an automatic method developed for extraction of pole-like objects using Mobile LiDar. LiDar scanning use because it can collect 3D road and road related geospatial information efficiently. It can collect the whole objects clearly and give the 3D image of the data. LiDar is an automatic scanning method, which scan the objects automatically without any instruction.

Pole like object detection methods:
Road object detection can be done by many methods like:

- Deep Learning CNN: It is a traditional method which only detect the direct objects like cars on the road, human detection which walk on the footpath.
- Vehicle based laser scanning: Vehicle based Laser Learning only detect the road vehicles, which are on speed, or off speed means which are running or which are stay on the side of the road.
- Remote sensing : Remote sensing method that uses light in the form of a pulsed laser to measure ranges (variable distances) to the Earth.

II. REMOTE SENSING TECHNIQUE

Today's world environment research is hard. For detection of environment object remote sensing technique is mostly using. Remote Sensing technique used into two technique methods:

1. LIDAR: light detection and Ranging
2. RADAR: Radio wave detection and Ranging

LIDAR (Light detection and Ranging): it is highly spatial technique which is use to detect the object from the height of 100km on the ground. Which make more attractiveness of the objects.

How it works:
Its working principle of LiDar is simple.LiDar set on high distance object like helicopter and it use laser pulse train which sent to ground target object and return to its source, then actual calculation for measuring that how far the object.

Mathematically:
Distance = (Speed of Light x Time of Flight) / 2

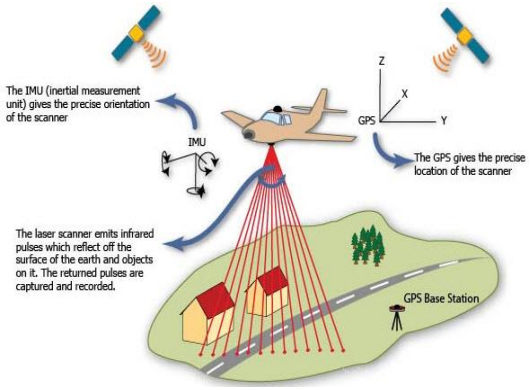

Fig. 1 Light detection and Ranging

III. LITERATURE REVIEW

1. **Li Yan et.al[2018]**found that LiDar use for detection of pole like road objects that is difficult to detect. It only detects the near object like furniture on road that is difficult to detect. But this technique detect the object from the upper point but it cannot give the clear image of what is detect.

2. **A. Jaakkola et.al[2008]** is a mobile laser technique that only detect the road objects which are near to the earth. And finding the irregular network of road models.
3. **Matti Lehtom et al found[2010]** research for road maintenance and 3D city modeling. VlS (vehicle based Scanning) which only detect the vehicles but road side objects are also important. It only detects 30% of the pole like objects.
4. **Faten Nahhas** found a building detection approach based on deep learning (DL) using the fusion of Light Detection and Ranging (LiDAR) data and orthophotos. The proposed method utilized object-based analysis to create objects, a feature-level fusion, an autoencoder-based dimensionality reduction to transform low-level features into compressed features, and a convolutional neural network (CNN) to transform compressed features into high-level features, which were used to classify objects into buildings and background.
5. **Bisheng Yang et.al** proposed method defines a set of rules for merging segments into meaningful units according to types of urban objects and forms the semantic knowledge of urban objects for the classification of objects. Finally, the proposed method extracts and classifies urban objects in a hierarchical order ranked by the saliency of the segments. Experiments show that the proposed method is efficient and robust for extracting buildings, streetlamps, trees, telegraph poles, traffic signs, cars, and enclosures from mobile laser scanning (MLS) point clouds, with an overall accuracy of 92.3%.
6. **Sheng Xu et.al** presented algorithm uses a bottom-up hierarchical clustering strategy to combine clusters belonging to no photosynthetic components. The combination process depends on the dissimilarity between two clusters. The measure in the proximity matrix calculation consists of a distance term using the Euclidean distance and a direction term based on the principal direction, respectively. The main contribution of this paper is to solve the optimization of cluster combination by minimizing the proposed energy function and to extract no photosynthetic components through a hierarchical clustering process automatically.
7. **Haiyan et.al[2016]** proposed pole like object detection by using supervoxel segmentation and bagof-contextual visual words. This technique tested on Mobile Lidar dataset. Drawback of this data it cannot detect the objects which are similar like light pole and traffic lights.
8. **Tee-Ann Teo et.al [2015]** proposed a method for extraction the features of lidar data by using coarse-to fine approach to improve the efficiency of MLS data. Coarse-to-fine is multi scale framework.
9. Zhizhong Kang **et.al[2018]** found a voxel-based method which automatically extract the 3D pole like objects. It first recognizes the same pole like objects and then find its vertical continuity of poles and then detect it.
10. Yongtao Yu **et.al[2015]** proposed a method of detection of pole like objects in urban areas. This researcher first form small regions of area and then detect the objects easily then using supervised learning approach for detecting the object(pole like objects).
11. **JaromírLanda et.al[2016]** proposed a directional method for detection the pole like objects which are connected through wires and difference between poles are very small is dangerous to overcome this problem directional method which use segmentation method.
12. **Celestino Ordóñez et.al[2017]** proposed a pole like object detection using SVM and machine technique and using LDA(linear discriminate analysis) method for detection objects for decreasing the low errors.
13. **Maher Ibrahim Sameen et.al[2017]** proposed a deep learning approach for detection the pole like road objects. This method used for improve the pixel quality of the object.
14. **Y. Li[2018]** proposed a method for orthophoto data objects using mobile mapping system using data acquired by MMS and then using faster R-CNN for region detection.
15. **Lehtomäki[2018]** formed a method which work which work on spare and unevenly distributed road object. For that detection of these objects it used four steps to detect the objects. But the drawback of this research it can not detect the object correctly. It improved the average completeness of objects.
16. **M. Neubert[2016]**proposed a method for extraction of rail line objects from high resolution helicopter borne lidar and ortho-image data. For detection of objects it use RANSAC algorithm. It improved the accuracy of the detection of objects.

IV. PROPOSED WORK

In this, we discussed the implementation of new algorithm of detection of pole side objects with LiDar and orthophoto Fusion.

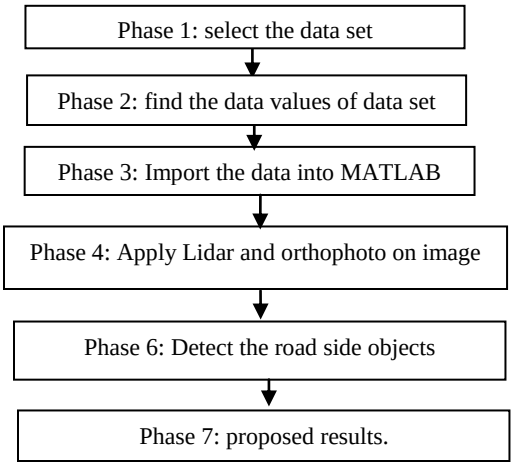

Fig. 2 block diagram of

V. ORTHOPHOTO

An **orthophoto** is an aerial photograph that has been geometrically corrected or '**ortho-rectified**' such that the scale of the photograph is uniform and utilized in the same manner as a map. An ortho-photograph can be used to measure true distances of features within the photograph. Planimetric corrections have been applied to remove lens distortions and optics, camera angle, and differences in elevation (topographic relief) through a process of measuring ground control points to 'tie' the photo to the ground, in a drawing-pin like manner. An orthophoto is an accurate representation of the Earth' s surface. Orthophotos have the benefits of high detail, timely coverage combined with the benefits of a map including uniform scale and true geometry.

Photomapping can provide the following scanned and geo-referenced products:

- Digital Ortho-photography
- Orthophoto Mosaics
- Digital Scanning
- Raster to Vector Digitisation
- Geo-Referenced Images
- Digital & Hardcopy Services
- Archival Photography
- Satellite Imagery

Fig. 3 High Resolution Orthophoto image

- Pixel size 0.08m
- Useful to provide highly detailed representation of important infrastructure
- Ideal for data identification and collection

VI. RESULTS AND DISCUSSION

i. Proposed detection of road side objects:

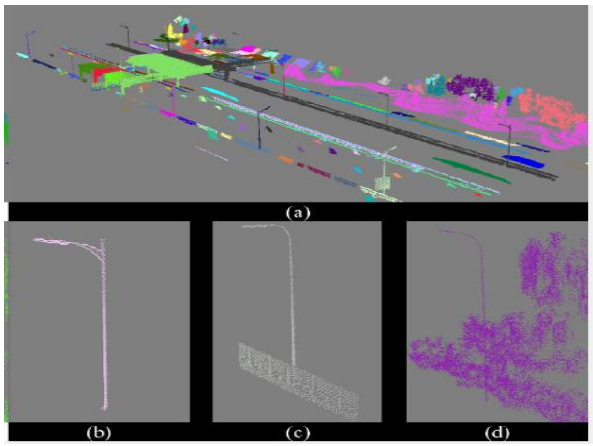

Fig. 4

ii. Compare the existing histogram with proposed histogram

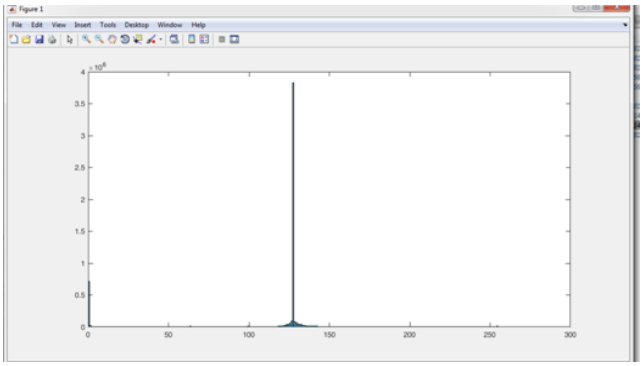

Fig. 5

iii. Comparison between the real object detection and proposed object detection:

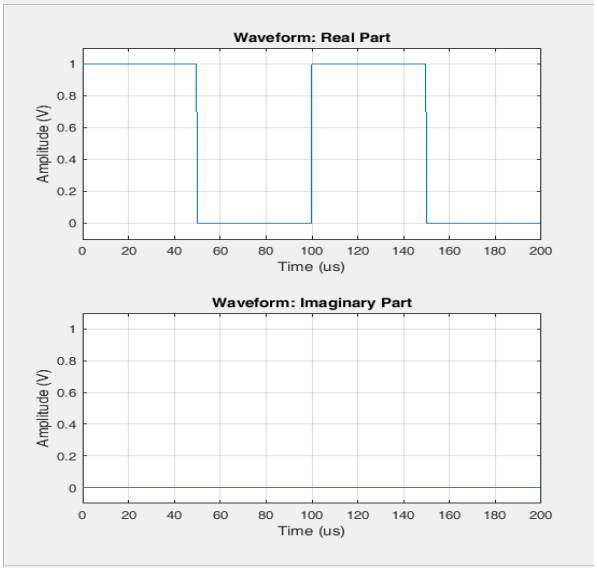

Fig. 6

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